



Northeast Fisheries Science Center Reference Document 10-11

# Northeast Fisheries Science Center Cetacean Biopsy Training Manual

by Frederick Wenzel, John Nicolas, Finn Larsen, Richard M. Pace, III

June 2010

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by Frederick Wenzel<sup>1</sup>, John Nicolas<sup>2</sup>, Finn Larsen<sup>3</sup>, and Richard M. Pace, III<sup>1</sup>

<sup>1</sup>NOAA National Marine Fisheries Service, 166 Water St., Woods Hole, MA 02543

<sup>2</sup>Columbia University, Office of Marine Operations, Palisades, NY 10964

<sup>3</sup>CETA-DART, c/o Charlotte Hastrup, FINDERUPVEJ 2 C, 3.th. DK-8000 ÅRHUS C. DENMARK

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# INTRODUCTION

In the waters of the United States, all marine mammals are protected under the U.S. laws of the Marine Mammal Protection Act (MMPA) and Endangered Species Act (ESA). The National Oceanographic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), Northeast Fisheries Science Center (NEFSC), Protected Species Branch (PSB) is permitted by NOAA, National Marine Fisheries Service, Office of Protected Resources Permits, Conservation and Education Division, (1315 East-West Highway, Room 13702, Silver Spring, MD 20910) under the MMPA and ESA to approach and biopsy a limited number of marine mammals per year. Each year, NEFSC submits an annual report to the U.S. Marine Mammal Commission and National Marine Fisheries Service, Office of Protected Resources, Permits, Conservation and Education Division, Permit Division, providing information on the number of marine mammals approached, harassed, biopsied, tagged under this Permit by our scientists. This obligation to document the approach, potential harassment, and permit process to conduct humane and scientific biopsies, also compels the NEFSC, Protected Species Branch to produce this Cetacean Biopsy Training Manual.

Since 1995, scientists at the Northeast Fisheries Science Center have collected thousands of biopsy samples from wild cetaceans in the Northwest Atlantic Ocean from the Caribbean Sea (Dominican Republic) north to Cape Hatteras (North Carolina) to the waters east of Cape Canso (Nova Scotia, Canada), and out to the wall of the North Atlantic Gulf Stream. We have used a variety of methods to take biopsy samples from nine *Odontocete*, five *Balaenopteridae* and one *Balaenidae* species. The biopsy method that has been most successful for us involves crossbows and the *CETA-DART*® bolt and cutting head. To use crossbows humanely and efficiently for sampling cetaceans in the wild, one must pay constant attention to detail and be very vigilant on safety issues. We also have to be flexible enough to adapt our biopsy approach and method to different species, platforms, as well as conditions at sea.

This training manual is designed to familiarize you with the use of a potentially dangerous weapon in a scientific mission – in the collection of biopsy samples from live cetaceans. The manual includes information and instruction in seven general areas:

- Personal Safety – communication, education and situation awareness
- Personal Safety around Firearms
- Small Boat and Large Vessel operations
- Crossbow mechanics – system and maintenance
- Safety around Cetaceans and Cetacean Behavior
- Exercises and Drills (target practice)
- Storage and Handling of Biopsy Samples

The manual is designed to be augmented by one-on-one training by biopsy experts for lectures and hands on -on-the-water exercises. We do not view this manual as a license to use crossbows without supervision, but rather as the necessary step in an apprenticeship that includes serving as an **arbalester (darter/marksmen)** during biopsy expeditions. We hope this manual will be useful to anyone involved in a cetacean biopsy expedition, whether or not they are the arbalester.

If you have the skills and desire to become an arbalester, this training manual will permit you to serve an apprenticeship in which you are coached by one or more of the veteran cetacean biopsy experts. After you complete a series of biopsy exercises, you will be evaluated and provided with additional coaching, as needed. The length of apprenticeship will vary, depending

on each individual's ability to learn safety procedures and general skills needed to become an expert arbalester. Similar to curling, golfing or race car driving, not everyone will be an expert or professional in this field.

## PERSONAL SAFETY ON SMALL BOATS

It is important that everyone understands the principles of small boat safety, and the rules and regulations of the NOAA Small Boat Safety Program: <http://www.sbp.noaa.gov> and the NOAA Small Boat Standards and Procedures Manual.

- PFDs (Personal Floatation Devices) must be worn at all times
- Situation Awareness: It is important that you are aware of your surroundings (who and what is where)
- Keep feet clear from lines and other gear on the boat deck
- Keep a solid footing
- Never aim the crossbow past 270° or 90° degrees relative to the boats heading.
- Loaded and cocked crossbows are always to be aimed outboard and never placed on the deck or left unattended.
- Do not hesitate to bring potential hazards or problems to the attention of the coxswain and/or other team members.
- If at any time you question an action you are about to execute: ***Don't do it!!***
- The coxswain will inform the arbalester as to the position of the animal and other logistics such as how, where and when the vessel will approach the targeted animal.
- Be aware that in a small boat, it is often difficult for those behind you to hear your voice over the wind and engine. Make sure all members of the team can hear you, or use agreed upon hand signals. Use of communication headsets can improve the communication on board, especially during the final approach phase, where it is important that the arbalester looks at the target and can use both hands for aiming the weapon.

## PERSONAL SAFETY AROUND FIREARMS

Although we are using crossbows for scientific purposes, we have to remember that they are every bit as dangerous as a loaded firearm. You must at all times treat the crossbow with respect and adhere strictly to the basics of firearm safety. The National Rifle Association's guidelines for firearm safety are below and are applicable for crossbows.

<http://www.nrahq.org/education/guide.asp>

### **1. ALWAYS keep the gun/crossbow pointed in a safe direction.**

Loaded and cocked crossbows are always to be aimed outboard and never placed on the deck or left unattended.

### **2. ALWAYS keep your finger off the trigger until ready to shoot.**

### **3. ALWAYS keep the gun/crossbow unloaded until ready to use.**

#### **4. Know your target and what is beyond.**

Be absolutely sure you have identified your target beyond any doubt. Equally important, be aware of the area beyond your target. This means observing your prospective area of fire before you shoot. Never fire in a direction in which there are people or any other potential for mishap. Think first. Shoot second.

#### **5. Know how to use the gun/crossbow safely.**

Before handling a gun/crossbow, learn how it operates. Know its basic parts, how to safely open and close the action and remove any ammunition/bolt from the crossbow, gun or magazine. Remember, a gun's/crossbow mechanical safety device is never foolproof. Nothing can ever replace safe handling.

#### **6. Be sure the gun/crossbow is safe to operate.**

Just like other tools, guns and crossbows need regular maintenance to remain operable. Regular cleaning and proper storage are a part of general upkeep. If there is any question concerning a crossbow's ability to function, a knowledgeable person should look at it.

#### **7. Use only the correct ammunition for your gun or bolt for your crossbow.**

Do not shoot/discharge the gun or crossbow unless you know you have the proper ammunition/bolt. A marksman/ arbalester should never "dry shoot" a crossbow.

#### **8. Wear eye and ear protection as appropriate.**

Guns are loud and the noise can cause hearing damage. They can also emit debris and hot gas that could cause eye injury. For these reasons, shooting glasses and hearing protectors should be worn by marksmen and spectators when using guns.

#### **9. Never use alcohol or over-the-counter, prescription or other drugs (at sea; including motion sickness medicine) before or while using Firearms.**

Alcohol or over-the-counter, prescription or other drugs (at sea; including motion sickness medicine), as well as any other substance are likely to impair normal mental or physical bodily functions, and must not be used before or while handling or shooting guns or crossbows.

#### **10. Store guns/crossbows so they are not accessible to unauthorized persons.**

Many factors must be considered when deciding where and how to store guns/ crossbows. Dozens of locking storage devices, as well as locking devices that attach directly to the gun are available. However, mechanical locking devices, like the mechanical safeties built into guns, can fail and should not be used as a substitute for safe gun handling and the observance of all safety rules.

#### **11. Be aware that many Firearm activities may be limited in certain states.**

Crossbows are allowed for hunting in only a limited number of states. In Massachusetts (and many other states) crossbows may only be used by handicapped hunters.

<http://www.huntersfriend.com/crossbows/crossbow-state-regulations.htm>

#### **12. Cleaning**

Regular cleaning is important in order for your gun/crossbow to operate correctly and safely.

Taking proper care of it will also maintain its value and extend its life. Your gun/crossbow should be cleaned every time that it is used. At sea, salt water is very corrosive. A crossbow brought out of prolonged storage should also be cleaned before shooting. Accumulated moisture and dirt, or solidified grease and oil, can prevent it from operating properly. Before cleaning your gun/crossbow, make absolutely sure that it is unloaded. Also, be sure that no ammunition is present in the cleaning area.

## **PERSONAL SAFETY AROUND CROSSBOWS**

**1.** Like most quality firearms, your CROSSBOW comes equipped with a manually engaged safety catch. This system is stronger and more reliable than an automatic safety under hunting conditions, but requires your attention to move it to the safe (down) position when the crossbow is cocked.

**Immediately upon cocking the crossbow you must set the safety, before removing your foot from the stirrup to pick it up.** Never disengage the safety catch until you are ready to shoot and the bow is pointed in a safe direction. Be sure to re-engage the safety if you do not shoot!

**2.** Always remember to treat your crossbow with the same respect due any sporting arm. It can be dangerous and deadly if mishandled.

**3.** Always check your crossbow thoroughly for worn, loose, damaged or missing parts prior to shooting. This will help you avoid malfunctions and possible injury to you, your crossbow, or someone else.

**4. Never dry fire your crossbow.** This can damage your crossbow and will void your warranty.

**5.** Never point your crossbow at anything you do not intend to shoot. After cocking your crossbow always ensure that the safety is properly engaged immediately.

**6.** Never release the safety until you are ready to shoot.

**7.** Do not attempt to modify the safety or trigger mechanism in any way.

**8.** Never shoot any projectile in your crossbow other than crossbow arrows designed specifically for use with your crossbow.

**9.** Always unstring your bow if it is to be exposed to extreme heat, such as in an enclosed area on a hot day. Excessive heat may damage the limbs (prod) of your crossbow.

**10.** Replace the bow string as soon as it shows any significant sign of wear.

**11.** Be sure of your target. Be aware of what is beyond your target!

**12.** Before shooting, be sure the crossbow limbs (prod) will not strike other obstacles.

**13.** Inspect your arrows regularly for signs of wear, splits, dents or anything that might weaken them. Tremendous stress is placed on crossbow arrows as they are released and damaged arrows could break causing possible injury to the arbalester.

**14.** Never place any part of your body into the path of the string or limb (prod) travel when your crossbow is cocked. **Be sure that your fingers and thumb are below the crossbows deck before every shot.**

**Adapted From the Instruction Manual of the Recurve Crossbow,  
EXCALIBUR CROSSBOW INC.**

2335 Shirley Drive

Kitchener, Ontario, Canada N2B 3X4

[www.excaliburcrossbow.com](http://www.excaliburcrossbow.com) Email: [service@excaliburcrossbow.com](mailto:service@excaliburcrossbow.com)

## **GENERAL SAFETY AND COMMUNICATION (SMALL BOAT)**

The NEFSC conducts small boat cetacean biopsy operations on various platforms. The most common is the rigid hull inflatable boats (RHIB). When using small boats, our cetacean biopsy collection team typically consists of: (1) an arbalester, (2) recorder, (3) photographer, and (4) a coxswain.

### **Personal Duties and Tasks (Small boats)**

The **arbalester** is responsible for biopsy operations, including the safety and handling of the crossbow, bolts, cutting tips, ensuring that there are sufficient supplies, conducts daily maintenance, safety checks and repairs to the crossbow and bolts, etc.

The **Recorder** is responsible for recording all cetacean sightings (time, location, species, number of animals, etc), recording harassment data, photographic information, and pertinent biopsy data logs. The recorder may also be responsible for preparing, labeling and short-term storage of biopsy samples.

The responsibility of the **Photographer** depends on the mission. However, most of the time the photographers job is to obtain photographs for individual identification of the targeted animals and to document the cetacean biopsy attempt (exact sample location, pre and post behavior, etc).

The **Coxswain** is responsible first and foremost for the safety of the crew, and the maintenance and operation of the vessel. The coxswain also is responsible for positioning the vessel so the arbalester has a clear and safe shot at the target. Most important is the coxswain's ability to communicate, especially to the **Arbalester** and direct the overall safe operations on board the small boat.

*Regardless of what role you are playing, safety is the first and foremost responsibility at all times during crossbow biopsy operations. We have zero tolerance for any conduct or procedure that may in any way be dangerous for either a co-worker or an animal. In the excitement of the operations, people who are inexperienced and those who have not*

*developed good safety habits may put themselves or other members of the team at risk. Everyone involved in a biopsy operation should be vigilant about safety and quick to point out anything they believe may be a safety risk.*

### **Small boat operations:**

Safe operating speeds are to be maintained at all times. All cetaceans react differently when being approached and the small boat operator should have a repertoire of numerous approach techniques for several cetacean species. It is acceptable for the **arbalester** to have the crossbow cocked and ready with the safety in the “on” position; however, a bolt should not be loaded into the firing position until just prior to a darting attempt. A cocked and loaded crossbow should never be placed on the boat deck. Always remove the bolt and un-cock the crossbow if it is not in use.

Following a shot, extreme caution will be exercised during the bolt retrieval process--it is always possible that someone could lose their balance and go overboard when retrieving the floating bolt from the water.

## **GENERAL SAFETY AND COMMUNICATION (LARGER SHIP)**

Aboard a larger vessel, the biopsy team usually is stationed at the bow where it conducts biopsy operations using tethered bolts fired from crossbows with a variety of different power characteristics (i.e., pull of 100, 150, or 165 lbs<sup>1</sup>). Occasionally, a single biopsy person may be stationed on the aft deck to attempt biopsy operations on animals that approach from the stern. We have also used un-tethered bolts that can be retrieved with a long handle net. A member of the scientific party is assigned to coordinate and direct the bridge to approach the target cetacean(s). Communications between the foredeck and the bridge are conducted via VHF handheld radios or similar device. During shipboard biopsy operations, we generally work with three to six staff, each of whom has a specific task.

### **Personal Duties and Tasks (Large Ship)**

There are several small differences between biopsy operations and team safety when operating from a small boat (RHIB), to operating from a larger ship. For safety reasons, we must remember that whenever marine mammals/cetaceans are close to a large ship, they will always attract enthusiastic observers, photographers, ships’ crew, etc. A small boat has only 4 people, and a large ship will have both the scientific party and the members of the ship’s crew, possibly dozens of people. This increase of personnel, also presents unique challenges because the curiosity generated by untrained, unsupervised observers, requires heightened situation awareness and greater communication and education to everyone on board.

The **Arbalester** is responsible for the remote biopsy procedure. In most cases there will be only one arbalester. However, when we pursue bow riding dolphins from a large vessel, we may add a second arbalester/darter. In this event, each arbalester is stationed 2-3 meters from the bow, one on port and one to the starboard rail/side. It is most important that the two marksmen

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<sup>1</sup> “lb” Refers to foot pounds of force. Foot pounds of force is defined as a unit of work done by a force of one pound through a distance of one foot in the direction of the force. ( *Merriam Webster Dictionary* )

communicate, for personnel safety and to eliminate the possibility of “double shots” on the same cetacean at the same time.

The **photographer** is responsible for the photo-documentation of the biopsy. Some key characteristics or events the photographer focuses on are: species identification, pre- and post-biopsy impact behavior, and unusual marks or scars.

The **recorder** is responsible for recording the biopsy. The recorder maintains the photo biopsy/harassment log (Appendix 2) (see Mesnick et al. 1999). When we use two arbalesters, we assign a recorder to work with each arbalester.

**Sample Preparation** - One person will be assigned to prepare, preserve and label each biopsy sample. (See the section on Storage and Handling of biopsy samples).

### *Large ship operations:*

Biopsy collection from large ships is significantly different than small boat collection and can be safely accomplished in conditions up to Beaufort 6 as opposed to a Beaufort 4 in small boats. Of course, in higher sea states, more caution and “common sense” is required. The biopsy bolts are the same as were used from the small boat except they are tethered by a long piece of parachute cord for easy retrieval. The tether line should be checked frequently to ensure it is clear of hang-ups. With retrieval, the person hauling the tether line/bolt should be aware of the possibility of kiting (the flight of the bolt caused by the combined wind speed and ship speed). The bolt can inadvertently get tangled in the ship’s anchor or fly (kite) over the gunnels into the path of the scientific party.

Loaded and cocked cross bows are always to be aimed outboard and never placed on the deck or left unattended. In both small boat and large ship operations only individuals with sufficient experience should be designated as the **arbalester**. A good rule of thumb is that if you have to ask yourself “SHOULD I BE DOING THIS?” Chances are you SHOULD NOT.

## **CROSSBOW SYSTEMS (MECHANICS AND MAINTENANCE)**

During this portion of manual, we will conduct both lectures or discussion and practical “hands-on” exercises on the mechanics and maintenance of a variety of crossbows of different pull strengths and configurations (i.e., standard and compound). Exercises will focus on:

- Bolts - inspection
  - Cutting Heads/Biopsy tips
  - Nock
  - Fletches/Vanes
  
- Crossbow – inspection and use
  - Stock
  - Safety “On/Off Switch”
  - Foot Stirrup
  - Trigger Mechanism
  - Nose Bolt
  - Hold Down

- Limbs/Prods
- Strings
- Assemble crossbows in accordance with manufactures specification – DO NOT Modify your equipment. You may not remove your stirrup, change out prods, strings with equipment that is not in accordance with manufacturer’s specifications.
- Before Cocking/Engaging/Loading/Activating the crossbow, the marksmen must be familiar with his/her equipment, as well as operating it safely.

**Bolts** - “A shaft or missile designed to be shot from a crossbow or catapult.” (*Merriam-Webster Dictionary*). We primarily use bolts that are custom designed and produced by *CETA-DART®* Aarhus, Denmark (Dr. Finn Larsen), however there are a variety of tested biopsy bolts designs which are available. The Finn Larsen shaft is constructed of an aluminum/carbon fiber sandwich, *Easton® model ACC 3-71/300*, with a total length of 55 cm. The high pressure polyethylene flotation molded on the forward portion of the bolt is 100 mm long, with a taper tapering from 27mm at the forward to 15mm at the rear. The bolts have three vanes or fletchings, 12.7 cm long, affixed at the back end of the bolt.

Bolts should be inspected frequently for stress related damage. Common problems include shattering of the shaft (usually in the forward section near the molded flotation), damaged fletchings, damaged flotation, or thread damage to the aluminum cutting head post. Newer bolts have stainless steel head posts. Shattered shafts should be discarded to ensure they are not used again. Damaged fletchings can be repaired in the field. Damaged flotation in some cases can also be repaired in the field. If the bolt is bad (showing signs of stress fracture)...mark it for disposal, or safely break the bolt in half to avoid the chance that someone else will attempt to use it.

Thread damage such as bending or dirty threads can also be repaired, however striped threads can not. Striped thread bolts should be discarded. Only non-petroleum based lubricant (*K-Y Jelly®*) should be used on the threads. Clean with ethanol.

**Cutting Head/Biopsy Tip** - The cutting head is the threaded stainless steel component of the bolt that is responsible for collecting the sample. We use cutting heads designed and produced by *CETA-DART®*, 25mm and 40mm long with a 7mm internal width and 9mm external width. Both cutting heads have three retention barbs affixed internally to assure maximum sample retention and a single (or double) vent hole to allow water and air pressure to escape during impact. All cutting heads have an *M8* thread for easy exchange.

In most cases, the 25mm head is used for dolphins and small whales; the 40mm head is reserved for the large whales (cetaceans).

Cutting heads should be inspected frequently for damage. Common problems include: missing barbs, clogged vent holes, and dull cutting edges. Cutting heads with missing barbs can not be repaired in the field and should be removed from use, returned to shore and returned to *CETA-DART* for repair. Clogged vent holes can be cleaned and dull cutting edges can be sharpened.

**Nock** - The nock is a molded plastic sleeve 9.5 mm outside diameter X 29.2 mm length fastened to the aft end of the bolt behind the fletchings. The nock has a concave notch located on the aft portion. This notch fits over the string and inside the trigger mechanism when the bow is cocked. On the Barnett’s crossbow the nock sits up against the string retaining latch when the bow is

cocked and only makes contact with the string when the latch is removed, i.e. when firing the crossbow. The nock should be inspected for wear. A worn nock will not fit properly into the trigger mechanism or on the string and will produce loss of power and/or inaccurate flight. Worn nocks can be removed from the bolt and replaced in the field.

**Fletches/Vanes** - The fletchings add to the aerodynamic quality of the flight. The three fletching are of two colors. The odd colored fletching designates how the bolt is positioned, with the “odd-color fletching” positioned downward in to the crossbow stock.

## **Crossbow – Inspection and Use**

**Crossbow Stock** - The stock is the one-piece molded fiberglass portion (or wood) of the crossbow that accommodates all of the components of the apparatus. The stock is almost maintenance free, however it should be wiped down with a damp freshwater cloth at the end of each day to remove salt residue, and inspected for obvious damage. Particular attention should be given to the front portion of the stock that attaches the prod. Check the nose bolt for tightness and the position of the rubber shims and prod, all of which should be centered.

**Foot Stirrup** - The foot stirrup is simply a metal stirrup fastened to the forward portion of the stock, near the nose bolt. The marksman positions his or her foot through the stirrup and holds the stirrup firmly to the boat deck and the stock pointing upwards, then takes secure grip on the string, and pulls back until the string is engaged (secured) inside the trigger mechanism. Do not remove the stirrup from the crossbow.

**Trigger Mechanism** - Although the entire crossbow requires little maintenance, the trigger mechanism is subject to significant mechanical wear and degradation from the salt water environment in which we operate. The trigger mechanism is composed of just three components: the trigger return spring; the string retaining latch, and the safety catch. The trigger mechanism is a simple mechanical device but it nevertheless requires daily inspection and preventative maintenance. If any of the three mechanical components fail, you may have a dangerous situation – the most serious of which is unexpected firing. To gain access to the mechanical components, remove the two bolts located on the under side trigger assembly fore and aft; then slide the entire mechanism out of the stock. Visually inspect the trigger return spring, string retaining latch, and safety catch/latch. Should any of the components appear worn, discard and replace the entire assembly. None of the individual components are replaceable. Routine maintenance includes fresh water rinse, towel and air dry and light application of machine oil or similar product.

**Safety catch/latch** - The safety catch/latch is either located on the left or right side of the stock above the trigger mechanism, depending on the crossbow model and design. If the safety is “ON”, the marksman will be unable to engage/load/cock the string. The safety must be off to engage/load/cock the crossbow string, then safety “ON” when loading the bolt. The safety should always be in the “ON” position until just before a shot is taken.

**Nose Bolt** - The nose bolt is often a head bolt used to affix the prod to the forward section stock. The bolt should be inspected frequently for tightness. A loose nose bolt will allow the prod to slide out of center, causing inaccurate flight.

**Hold Down/Arrow Retention Spring** - The hold down is a thin piece of steel, approximately 50 mm long and 6.4 mm wide, fastened to the top of the stock above the trigger mechanism underneath the aft sight assembly. After the crossbow is cocked, safety “ON”, and ready, the bolt slides under the hold down, keeping the nock in the trigger mechanism and keeping the bolt from sliding off of the stock.

**Prod** - The prod is the portion of the crossbow mechanism that provides the foot pounds of force to launch the bolt. Constructed of molded fiberglass, it is fitted, centered and fastened to the forward portion (nose) of the stock with a single nose bolt and shimmed with two 25mm L X 25 mm W X 6.3 mm thick rubber inserts, one forward and one aft of the center of the prod.

Inspect the prod regularly for stress damage. Pay particular attention to the center of the prod where it attaches to the stock. Stress damage is revealed by splintering of the fiberglass. If you see stress splintering, remove the crossbow from service and remove, discard and replace the damaged prod immediately. Damaged prods under pressure may break and cause serious injury to the arbalester. Other than inspection for stress damage, no routine maintenance is required.

**String** - The string is the portion of the crossbow that comes in contact with the nock and launches the bolt. The strings are constructed of twisted cotton - acrylic or Dacron. The pre-measured and fitted string is attached under pressure to each end of the prod. Depending on air temperature, the string should be waxed each 10-20 shots. Hot weather will cause the wax to deteriorate more rapidly than colder weather. Inspect the string frequently for wear. If you see threads of the twisted string beginning to fray or unravel, change it immediately. A worn string can cause inaccurate flight and may break under pressure. Eye protection is recommended when changing and installing the crossbow string.

**String replacement** – The owner’s manual will demonstrate how to replace a worn string as each crossbow model is slightly different. Often an extra pair of hands and safety glasses is recommended.

## **SAFETY TOWARDS THE CETACEAN**

- The **Arbalester** should always aim high on the lateral side of the animal, just below the dorsal fin or dorsal ridge. This principle holds for both large and small cetacean targets. The arbalester is absolutely *forbidden* to shoot at any whale or dolphin approaching head-on.
- The arbalester will not shoot at an animal which is closer than appropriate given the draw strength of the crossbow and more importantly the estimated exit velocity of the dart/bolt. For a 150lb draw Barnett Panzer crossbow, which has an exit velocity of approximately 245feet/s one should not dart an animal closer than 4 meters.
- Depending on the cetacean species, there may be limitations on darting calves. The arbalester should never shoot at a calf *without having first consulted* with the Chief

Scientist or field party chief, and the limitation(s) of your Biopsy Permit from NOAA, Office of Protected Resources, Permits, Conservation and Education Division.

- **Impact Behavior**– It is important to describe the impact and behavior of the biopsy attempt on the targeted animal. (No or none, low, medium, high reactions are possible for all encountered species). No one wants to see a high behavioral reaction, negative behavior, serious injury or death to an animal (see Bearzi 2000).

## WHALE AND DOLPHIN BEHAVIOR

Large, medium or small, all cetaceans express unique behaviors. To collect biopsies successfully you need experience with your targeted species unlimited behavioral expressions and under different sea conditions. Some of the behaviors to consider are listed below – each behavior requires a unique level of expertise, communication and coordination between the coxswain and the entire crew.

**Logging** - Animals that are “logging” are presumed to be resting – lying all but motionless at the surface. Several cetacean species have been observed logging. Sperm whales probably typify this behavior most accurately. Logging has also been observed with right, humpback and beaked whales. Dolphin species apparently rest simply by slowing their rate of movement (travel). Pilot whales and the *Kogia sp.* have been observed motionless in a vertical position in the water column.

**Milling** - *Milling* is defined as moving slowly in no set direction, meandering. For many species milling is also associated with resting.

**Traveling** - *Travel* is defined as “To move in a given direction or path or through a given distance; to transverse a specific distance” (*Merriam-Webster Dictionary*).

In cetacean research, *traveling* refers to an animal or animals moving at slow, moderate or fast speed in a set direction, exhibiting little or no deviation from a particular course. Traveling animals usually present a very good biopsy opportunity if the animals are moving in one constant direction with ample time spent at the surface.

**Charging or Porpoising** - This behavior is common among dolphin and whale species. *Charging/Porpoising* usually refers to a single or group of animals moving at a high rate of speed in a set direction. When a group is charging, you can see animals leaping high out of the water and unusual amounts of white water. Animals that are charging are among the most difficult animals to biopsy.

**Courtship** - *Courtship* behavior is probably most obvious among humpbacks and right whales. The male whale may become extremely competitive while pursuing a female. Other terms for courtship behavior are competitive groups or surface active group (Parks and Tyack 2005; Clapham et al. 1992).

We are extremely cautious about attempting biopsies with whales during observed courtship behavior. Keep in mind that the only thing more important to a whale than feeding is courtship!

**Bow-riding** - *Bow riding* is most common among dolphin species, although we have also observed this behavior with pilot whales. Dolphins may change course and travel several hundred meters towards the bow of a ship to catch a free ride on the bow wave, or they may approach the vessel from the stern and then approach the bow. Bow-riding presents an excellent opportunity for collecting biopsy samples from the bow of the larger ship. When large numbers of cetaceans (>10) are bow-riding, we sometimes use the two arbalester method.

**Cow/Calf Pairs** - The small boat crew must query the chief scientist as to the restrictions of your NOAA permit restrictions in reference to approaching and/or biopsying mother/calf pairs. Approach and biopsy procedures may be different for different species. When it is permissible to biopsy the mother/calf pair, the safety of the animals must be high priority.

In general, mother/calf pairs are a good target because they can not stay under water for long periods of time.

**Feeding** - Cetaceans are opportunistic feeders. Cetacean foraging strategies have been studied and described in the literature for decades. Foraging cetaceans may or may not be good biopsy targets for several reasons; good to poor photo-identification opportunities; time at surface vs. time at depth, etc. Patience is required when attempting to biopsy a feeding cetacean. However, *caution* must be exercised when approaching feeding animals for the very same reason: they may be preoccupied and may not be aware of your presence, and the vessel.

**Whale Watching and the curious whales and dolphin(s)** - You should be aware that some members of the general public and whale watching community have a deep concern of biopsy procedures (invasive tagging) on marine mammals. Be aware that while you are watching the whales and dolphins, people are watching you. Be prepared to show your research permit to the Coast Guard, to educate boaters, whale watching enthusiasts, harbor master, marine mammal stranding networks, etc. Please show respect, by not conducting biopsying attempts in front of a whale watching vessel, or other vessels.

## EXERCISES AND DRILLS

We assign specific tasks to each member of the biopsy team. In this segment of the training, you will have the opportunity to gain experience in conducting each task. You will also be given the opportunity to gain experience on each of the biopsy platforms conducting each of the assigned tasks. Exercises and drills should be conducted on appropriate platforms. On the water, the boat, the targeted animal, the marksmen are all moving. Learning how to use a crossbow on a moving boat is different than on land. Maintaining balance, coordination and situational awareness is important at sea, and more important when holding a crossbow, and even more important than shooting at a target.

We usually use two types of targets. These are often a “bullet-shaped” buoy, or a grapefruit or other floating large fruit. The buoy will float, will move, driven by both waves and wind, and will behave more like a moving target. A grapefruit, will sit partial submerged, float (or bob) with the waves, and be a smaller more challenging target.

It is most important to train staff with both on land and on-the-water training. The additional training aboard both small boats and larger ships should improve overall safe operations.

## STORAGE AND HANDLING OF BIOPSY SAMPLES

The preparation, storage and handling of biopsy samples can vary from mission to mission. During any one cetacean biopsy exercise, one or more protocols may be required. The chief scientist or researcher should demonstrate the specific biopsy processing protocol. Do not assume that you know how to treat biopsy samples because you have done it or seen it done before.

On a small RHIB, or bow of a large research vessel someone must take responsibility for the immediate handling, proper labeling, and short term, long term storage of the sample(s). Depending on the nature of the research project, some samples may be wrapped in clean/sterile aluminum foil, plastic zip-lock bag, glass tubes or plastic tubes with salt and Dimethyl sulfoxide (DMSO), or held on ice in a cooler.

A written and verbal protocol should be in place for the handling and storage of biopsy samples prior to the first bolt being fired.

### **Some suggested safety guidelines for biopsy sample preparation include:**

- Keep your work area as clean and dry as possible;
- Secure all objects that may slide/fall should the ship or RHIB take a roll;
- Do not leave sharp cutting instruments, glass jars, chemicals unattended. Use appropriate holders or receptacles;
- Be aware of other personnel – Small boat crew, ships, crew and other observers may be in the area, marine mammals close to a ship always attract curious onlookers.
- Always keep the team informed of the intended “plan.”
- Communication, data management, proper labeling and correct preservation of samples will prevent mistakes.
- Before leaving the ship’s lab at the end of the day, double check that all items are secure;
- The evening before, make sure the small boat and larger vessel’s biopsy kit has enough supplies for the next day’s operations.
- Should there be an incident, accident involving chemicals, or injury to personnel, report it immediately to the Chief Scientist

NOAA, NMFS Science Centers collection of cetacean biopsies support a range of research projects including; nuclear DNA, mitochondrial DNA, life history, stable isotopes, P450, toxicology, contaminants, species identification, population stock structure, maternal and paternal determination of offspring, hormone quantification, etc. Sample preparation and storage are often different depending on the objectives of the research project.

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# APPENDIX 1 – BIOPSY, HARASSMENT, AND PHOTOGRAPHY LOG

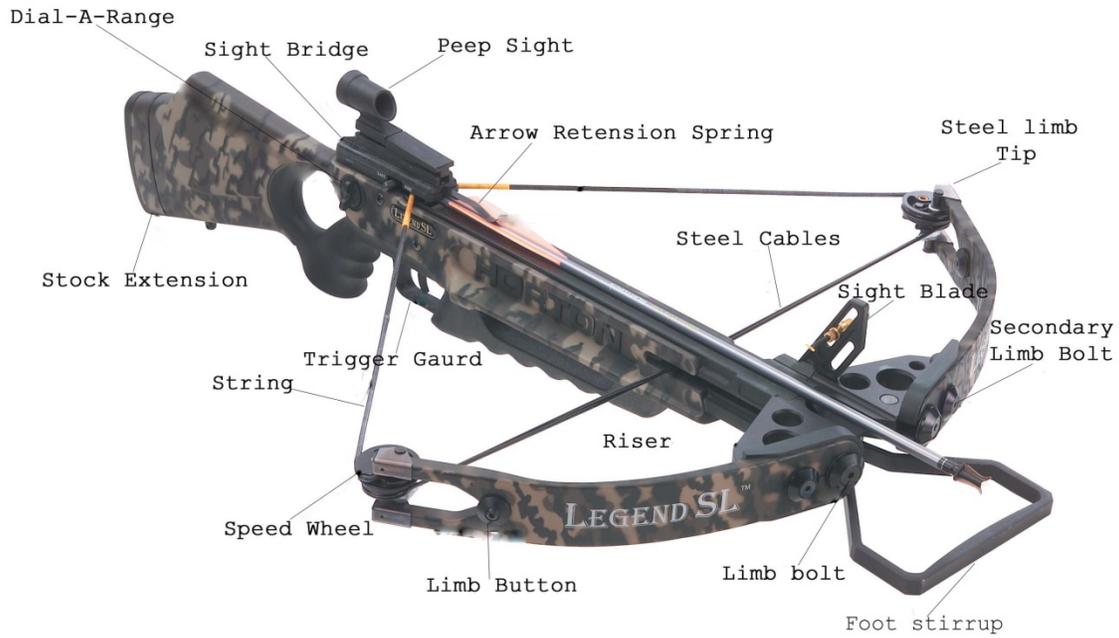
DATE: ___ \ ___ \ ___		SIGHTING #: _____		PAGE ___ OF ___	
<b>SIGHTING INFO</b>			RECORDER: _____		
Species:		Lat:		Long:	
Low:		High:		Best:	
				Calves:	
<b>BEHAVIOR</b>					
Before:		During:		After:	
<b>SAMPLE COLLECTION</b>			Platform:		Start time:
			End time:		
Sample #:		Time taken:		Distance (m):	
Sample type:					
Shot #	Result:		Impact: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		Assoc. with:
	Class:		Size:		Sex:
	Photos:				
	Notes: _____				<input type="checkbox"/> Gen <input type="checkbox"/> Tox <input type="checkbox"/> SI <input type="checkbox"/> 1HC
					
Sample #:		Time taken:		Distance (m):	
Sample type:					
Shot #	Result:		Impact: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		Assoc. with:
	Class:		Size:		Sex:
	Photos:				
	Notes: _____				<input type="checkbox"/> Gen <input type="checkbox"/> Tox <input type="checkbox"/> SI <input type="checkbox"/> 1HC
					
Sample #:		Time taken:		Distance (m):	
Sample type:					
Shot #	Result:		Impact: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		Assoc. with:
	Class:		Size:		Sex:
	Photos:				
	Notes: _____				<input type="checkbox"/> Gen <input type="checkbox"/> Tox <input type="checkbox"/> SI <input type="checkbox"/> 1HC
					
Sample #:		Time taken:		Distance (m):	
Sample type:					
Shot #	Result:		Impact: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		Assoc. with:
	Class:		Size:		Sex:
	Photos:				
	Notes: _____				<input type="checkbox"/> Gen <input type="checkbox"/> Tox <input type="checkbox"/> SI <input type="checkbox"/> 1HC
					

# APPENDIX 2 – CROSSBOW GRAPHIC

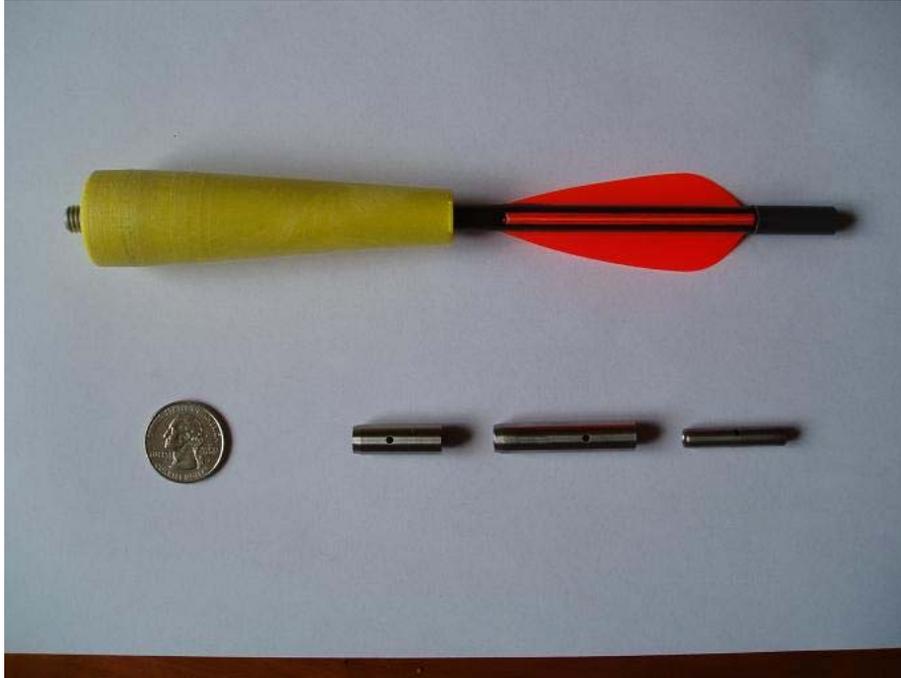
## Horton Legend SL Crossbows

<http://www.crossbow.com/uploads/legendexplodedview.jpg>

Legend SL 1998-2002  
165 lb to 175 lb  
String-ST140  
Cables-ST040



## APPENDIX 3 – BOLT AND CUTTING HEAD GRAPHIC



Threaded screw – Flotation – Bolt – Fletchings/Vanes - Nock

25 mm – 40 mm biopsy tips/Cutting heads

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